INTRODUCTION

Tasmania is regarded as having one of the best climates in the world for producing premium quality Pinot Noir table and sparkling wines. At present average yields are around 5 tonnes per hectare with quite a wide range. However there is a considerable body of opinion that this could be increased significantly to still produce fruit and wine of acceptable quality but with much improved economic returns.

This demonstration trial was set up to be the focus of an industry field day (November 2006) which has already been reported on in detail (Farquhar unpublished) in fulfilment of the original agreement. However we were encouraged to submit a further report including the harvest and post-harvest data. Some of this data was also presented to producers at subsequent field days in November 2007 and January 2008. It is also our intention to prepare an article for publication in the Australian and New Zealand Grapegrower and Winemaker.

The trial aimed to “push the limits” in terms of bud numbers, and consequently yield per hectare, and to determine the effects on fruit and wine characteristics.

METHODS

It must be emphasised from the outset that the trial was set up as a demonstration for one season and as will be seen from the design the treatments have not been randomly allocated thus limiting its value in a statistical sense. Consequently only basic statistical tests (simple correlation coefficients) have been used at this stage although there is a possibility that more sophisticated techniques might be employed in future to combine the data with that from other sites and thus enable wider conclusions to be drawn.
The trial was set up on two rows of Scott Henry (SH) and two rows of Vertical Shoot Position (VSP) trellis on the Relbia Vineyard of Josef Chromy Wines. There were six panels of three vines in each row and treatments were allocated to panels in order of increasing bud number. The treatments were replicated in the second row in each trellis type but in order of decreasing bud number to take account of possible site effects. Target bud numbers ranged from 8 to 96 per vine. The details of the treatments are shown in Figure 1.

**Figure 1 - Trial Layout and Treatments**

<table>
<thead>
<tr>
<th>PANEL</th>
<th>VSP ROWS</th>
<th>SCOTT HENRY ROWS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>33</td>
<td>31</td>
</tr>
<tr>
<td>1</td>
<td>8 canes/vine</td>
<td>2 canes/vine</td>
</tr>
<tr>
<td></td>
<td>12 buds/cane</td>
<td>4 buds/cane</td>
</tr>
<tr>
<td></td>
<td>96 buds/vine</td>
<td>8 buds/vine</td>
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<tr>
<td></td>
<td>231840 buds/ha</td>
<td>19320 buds/ha</td>
</tr>
<tr>
<td>2</td>
<td>6 canes/vine</td>
<td>2 canes/vine</td>
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<tr>
<td></td>
<td>12 buds/cane</td>
<td>8 buds/cane</td>
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<td></td>
<td>72 buds/vine</td>
<td>16 buds/vine</td>
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<tr>
<td></td>
<td>173880 buds/ha</td>
<td>38640 buds/ha</td>
</tr>
<tr>
<td>3</td>
<td>4 canes/vine</td>
<td>2 canes/vine</td>
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<tr>
<td></td>
<td>12 buds/cane</td>
<td>12 buds/cane</td>
</tr>
<tr>
<td></td>
<td>48 buds/vine</td>
<td>24 buds/vine</td>
</tr>
<tr>
<td></td>
<td>115920 buds/ha</td>
<td>57960 buds/ha</td>
</tr>
<tr>
<td>4</td>
<td>2 canes/vine</td>
<td>4 canes/vine**</td>
</tr>
<tr>
<td></td>
<td>12 buds/cane</td>
<td>12 buds/cane</td>
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<tr>
<td></td>
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<td>57960 buds/ha</td>
<td>115920 buds/ha</td>
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<tr>
<td>5</td>
<td>2 canes/vine</td>
<td>6 canes/vine**</td>
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</tr>
<tr>
<td></td>
<td>19320 buds/ha</td>
<td>231840 buds/ha</td>
</tr>
</tbody>
</table>

* 2 canes top wire, 4 canes bottom wire
** 4 canes top wire, 2 canes bottom wire
The vines were pruned on August 11 2006 at which time node and shoot counts and pruning weights per vine were obtained.

On November 7 2006 shoot and sucker counts per vine were obtained and shoot lengths measured.

The fruit was harvested on April 6 and 7 2007. Data obtained were primary and secondary bunch counts and fruit weights, and juice titratable acidity, pH and sugar level.

The vines were pruned again on June 29 2007 and pruning weights obtained.

Fruit from the two replicates was combined and 10 kg samples used to make individual wines from each treatment and trellis combination giving a total of 12 wines. The wines were made at the Experimental Micro-Vinification Facility at Tamar Ridge Estates. Various wine colour data was obtained from the wines (see results for details) and they were subjected to an informal tasting. They were also made available for tasting by producers at two separate field days.

RESULTS AND DISCUSSION

The raw data and the treatment means are presented in Appendix 1. Data from a small number of vines has been eliminated, as they were not considered representative of their treatment.

Response of the Vines to Pruning Level

The data presented in Figure 2 indicate that, as expected, there is a strong association between number of nodes laid down and number of shoots developing ($r^2 = 0.96$ SH and 1.00 VSP). However, the vines have compensated at both ends of the pruning scale with more shoots than nodes at the bottom of the range and less shoots than nodes at the top. Towards the middle of the range there is more agreement between target and actual. The message here perhaps is that no matter what we do the vine will fight back and endeavour to retain its own natural balance.

In Figure 3 it can be seen that pruning level had a marked effect on shoot length ($r^2 = 0.88$ SH & VSP). Once again it was expected that the more shoots there are, the shorter they will be. There was also a weak association between pruning level and the occurrence of suckers (Figure 4, $r^2 = 0.53$ SH & VSP). The vines again appear to be compensating for the low number of shoots by suckering from the trunk.

There was a strong association between pruning level and number of primary bunches (Figure 5, $r^2 = 0.96$ SH & VSP) and between pruning level and yield (Figure 6, $r^2 = 0.90$ SH, 0.81 VSP). Yields ranged from 8 to 28 tonnes per hectare. The photos in Appendix 2 show the fruit load at each end of the spectrum for both trellis types. The relationship between pruning level and secondary bunch number was weak or non-existent (Figure 7, $r^2 = 0.00$ SH, 0.12 VSP).
Figure 2 - Actual Shoot Count vs Pruning Level
\( r = 0.98 \text{ SH}, 1.00 \text{ VSP} \)

Figure 3 - Mean Shoot Length vs Pruning Level
\( r = -0.94 \text{ SH}, -0.94 \text{ VSP} \)
FIGURE 4 - SUCKER COUNT VS PRUNING LEVEL
(r = -0.73 SH, -0.73 VSP)

FIGURE 5 - PRIMARY BUNCH NUMBER VS PRUNING LEVEL
(r = 0.98 SH & VSP)
FIGURE 6 - YIELD VS PRUNING LEVEL  
\( r = 0.95 \) SH, 0.90 VSP

FIGURE 7 - SECONDARY BUNCH NUMBER VS PRUNING LEVEL  
\( r = 0.01 \) SH, -0.34 VSP
The Effect of Yield on Juice Parameters

The relationship between yield and both the juice sugar level (Figure 8, \( r^2 = 0.96 \) SH, 0.98 VSP) and pH (Figure 9, \( r^2 = 0.92 \) SH, 0.90 VSP) was as expected with both declining at the higher cropping levels. As yield increased from 8 to 28 tonnes per hectare, sugar dropped from above 25° Brix to around 18-19° Brix. Similarly pH fell from around 3.12 to around 2.95. To be “fair” to the higher yielding treatments it should be pointed out that all treatments were harvested over the same two-day period and there is every chance that the higher yielding treatments would have achieved more acceptable numbers had the fruit been allowed to remain on the vine until later in the season – the canopy was certainly still capable of further ripening the fruit at the time of picking.

It is also interesting to note that in both the case of sugar level and pH the Scott Henry trellis performed better than the VSP at similar yields thus indicating its potential for comparable quality at higher yields on a vigorous site such as this.

An unexplained anomaly in the results was the relationship between yield and titratable acid of the juice. The results obtained from the field samples were impossible to reconcile with the pH picture and must be attributed to technique. However, samples analysed at the winery showed only a weak correlation between the two parameters (Figure 10, \( r^2 = 0.42 \) SH, 0.30 VSP).
FIGURE 9 - JUICE pH (FIELD) VS YIELD
(r = -0.96 SH, -0.95 VSP)

FIGURE 10 - JUICE TITRATABLE ACID (WINERY) VS YIELD
(r = 0.65 SH, 0.55 VSP)
The Effect of Yield on Wine Colour Parameters

Figures 11-15 illustrate the relationships with yield for the colour measures total anthocyanins, total phenolics, wine colour density, wine colour density (SO₂ effects removed), and wine colour hue respectively.

Total anthocyanins \( (r^2 = 0.96 \text{ SH}, 0.92 \text{ VSP}) \), total phenolics \( (r^2 = 0.96 \text{ SH}, 0.83 \text{ VSP}) \), wine colour density \( (r^2 = 0.88 \text{ SH}, 0.96 \text{ VSP}) \) and wine colour density with SO₂ effects removed \( (r^2 = 0.90 \text{ SH}, 0.96 \text{ VSP}) \) were all strongly negatively correlated with yield. Once again the Scott Henry trellis performed better than the VSP at the same yield presumably due to better fruit exposure and/or higher canopy to fruit ratio.

Wine colour hue presented a different picture with only a weak association with yield and a tendency for higher values towards the middle of the yield range particularly in the Scott Henry treatments.
FIGURE 12 - TOTAL WINE PHENOLICS VS YIELD
(r = -0.98 SH, -0.91 VSP)

FIGURE 13 - WINE COLOUR DENSITY VS YIELD
(r = -0.94 SH, -0.98 VSP)
FIGURE 14 - WINE COLOUR DENSITY REMOVING SO2 EFFECTS VS YIELD
\( (r = -0.95 \text{ SH}, -0.98 \text{ VSP}) \)

YIELD (tonnes/ha)

WINE COLOUR DENSITY REMOVING SO2 EFFECTS (Abs_{520} + Abs_{420})

SH
VSP

FIGURE 15 - WINE COLOUR HUE VS YIELD
\( (r = 0.47 \text{ SH}, 0.48 \text{ VSP}) \)

YIELD (tonnes/ha)

WINE COLOUR HUE (Abs_{420} / Abs_{520})

SH
VSP
The Effect of Yield on Wine Quality

The wines were informally tasted on several occasions by a range of people. It is hard to come to a firm conclusion but it appears possible that an “acceptable” wine could be produced from fruit cropped as high as about 20 tonnes per hectare on the Scott Henry trellis and about 15 tonnes on the VSP trellis. Given that the fruit was all picked at the same time, this impression may have been further strengthened if the fruit had been harvested later at the higher cropping levels.

The Effect of Yield on Post-Harvest Parameters

The relationship between yield and mean cane weight, pruning weight and yield to pruning weight ratio are shown in Figures 16-18 respectively.

As expected mean cane weight was strongly negatively associated with yield falling from around 55g at the low yield to around 20g at the high yield ($r^2 = 0.92$ SH & VSP).

Pruning weight, on the other hand, was positively associated with yield as one would expect from the number of nodes laid down at the previous pruning. However the association ($r^2 = 0.55$ SH, 0.77 VSP) was much weaker than for mean cane weight.

Yield to pruning weight ratio was strongly positively associated with yield ($r^2 = 0.92$ SH, 0.98 VSP).
Relating these measures to the optimal values proposed by Smart and Robinson (1991) the pruning weights are somewhat confusing but if we concentrate on the mean cane weight and yield to pruning weight ratio it appears that the vines were in balance when yields were above about 15 tonnes per hectare.

**FIGURE 17 - PRUNING WEIGHT VS YIELD**

\( r = 0.74 \text{ SH}, 0.88 \text{ VSP} \)

(Smart & Robinson optimum 0.54-1.08kg/vine)

![Pruning Weight vs Yield Graph](image)

**FIGURE 18 - YIELD TO PRUNING WEIGHT RATIO VS YIELD**

\( r = 0.96 \text{ SH}, 0.99 \text{ VSP} \)

(Smart & Robinson optimum 5-10)

![Yield to Pruning Weight Ratio vs Yield Graph](image)
CONCLUSIONS

As stated at the outset this trial was designed as a demonstration rather than a rigorous scientific experiment. It was also run for only one season so no account is taken of carryover effects. Consequently, a certain amount of caution must be exercised in interpreting the results. However it does give some indication that Pinot Noir could be cropped at higher levels in some parts of Tasmania and still produce quality fruit. We are certainly not suggesting that producers start aiming for 15 or more tonnes per hectare but if it were possible to lift yields by even one or two tonnes the impact on the profitability of wine production in this cool climate region would be significant.

Further work on various aspects of the yield/quality relationship in this environment is warranted and the availability of the Experimental Micro-Vinification Facility at Tamar Ridge Estates provides the distinct advantage that such work can be carried right through to the end product.

REFERENCES

Farquhar, Duncan (unpublished) – Tasmanian Field Day, 9 November 2006, Quality Management, Pruning and Rootstocks (Field Day Report - GWRDC Project Number RT 06/02-2)

Smart, Richard and Robinson, Mike (1991) – Sunlight into Wine (Winetitles, Adelaide, South Australia)

ACKNOWLEDGEMENTS

We express our gratitude to many people who have contributed to this work and apologise for any omissions.

The project was conceived by the Technical Committee (Chair Jeremy Dineen) of the now defunct Vineyards Association of Tasmania and its successor, Wine Industry Tasmania. Duncan Farquhar (Department of Primary Industries and Water), Richard Smart (Tamar Ridge Estates) and Mark Brewer (Institute of TAFE Tasmania) were among the prime instigators.

It was conducted on the Relbia Vineyard of Josef Chromy Wines with the backing and input of Jeremy Dineen, Winemaker/Manager. Vineyard Manager, Steve Nash, and Vineyard Leading Hand, Michelle Cox, also provided significant support. With the blessing of the management Margarete Pfarr did an immense amount of work pruning, shoot counting and measuring, and harvesting. Kirsten Potowski (Assistant Winemaker) also assisted at harvest.

Sue Briggs of TAFE Tasmania assisted with the analyses at harvest.

Reuben Wells and Fiona Chopping, PhD students of the Tasmanian Institute of Agricultural Research, and their supervisor, Richard Smart, made the individual wines at the Experimental Micro-Vinification Facility at Tamar Ridge Estates.